11309
Design Memo

Niagara Falls, New York
July 13, 1983

Design Memo No. 1

File No. 11309

SUBJECT. Radiological Survey, Cleanup Options and Cost Estimates

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UNION CARBIDE

INTERNAL CORRESPONDENCE

METALS DIVISION

P O BOX 97, NIAGARA FALLS, NEW YORK 14302

To (Name) Mr. R. J. Klotzbach
Division UCC-Metals Division
Location Niagara Falls, NY

Date July 13, 1983

Originating Dept. Engineering Department

Answering letter date

Copy to See Attached Distribution

Subject Design Memo No. 1
Radiological Survey, Cleanup
Options and Cost Estimates
File No. 11309

Dear Bob:

Attached is Design Memo No. 1 "Radiological Survey, Cleanup Options and Cost Estimates".

Union Carbide Corporation presently is out of compliance with its New York Radioactive Materials License No. 950-0139 due to radioactive source concentrations in excess of 500 ppm behind Niagara Building 166, where access to employees is unrestricted. To identify the area and depth of contamination, the area south of Building 166 was surveyed by Mr. D. R. Brosnahan and the author. The results indicate that a soil volume of 5130 ft.^{3} must be restricted or removed for compliance with New York State regulations. An additional 1700 ft.^{3} must be removed for delicensing and unrestricted use.

The following five alternatives have been considered and cost estimates prepared as part of the design memo.

Alternative	Description	Cost
1	Fence in Place	$ 10,000
2	Remove & Fence on Elkem Property	65,000
3	Remove & Fence on UCC Property	120,000
4	Remove & Bury - UCC Niagara	175,000
5	Remove & Ship to a Repository	335,000

The recommendation is to proceed with Alternative No. 3, based primarily on the condition that the property will be deeded to Elkem Metals Company. The material remains available for implementing Alternative No. 4, "Bury on UCC Property", or Alternative No. 5, "Ship to an Approved Repository", in the future. An R & D effort can also proceed to investigate ways to reduce the volume. Far less expense is required for the alternative to "Fence in Place", which is recommended if property ownership does not change.

L. G. Evans

LGE/dac
Attachments

Union Carbide Corporation
Metals Division
Technology Department - Engineering
Niagara Falls, New York

File No. 11309

DESIGN MEMORANDUM
SPONSOR: T. J. KAGETSU

PROJECT: Soil Decontamination - South of Building 166, Niagara

BY: L. G. Evans/D. R. Brosnahan

DATE: May 20, 1983

Design Memo No. 1
Revision 0
Subject: Radiological Survey, Cleanup Options and Cost Estimates

1.0 INTRODUCTION

1.1 Scope

To include an engineering evaluation of the alternatives available for disposal of the radioactive contaminants from areas south of Building 166.

1.2 History

The U. S. Department of Energy performed surveys in 1976 to assess the radiological status of facilities utilized under Manhattan Engineer District contract during the period 1943-1946. UCC's Metals Division at Niagara was one of those sites. They discovered contamination South of Building 166 and notified Union Carbide and New York State.

As a result, New York State Department of Labor performed a follow up survey on December 1, 1981 and cited UCC for violation of its New York Radioactive Materials License No. 950-0139 by storing source concentrations in excess of 500 ppm without restricting access to employees.

Later, thorium was found to be a major radioactive contaminate indicating that the radiation is unrelated to the Manhattan Engineer Project.

This problem is further complicated by the divestiture of the ferroalloys business and anticipated eventual ownership of the property by Elkem Metals Company.

2.0 DISCUSSION

2.1 General

All phases of a waste clean up project are directly affected by the quantity of waste to be handled. Therefore, the first priority was to develop a reasonably good estimate of the volume.

A gamma radiation survey was performed over the entire fenced area behind Building 166 to determine the area of involvement excluding areas covered by asphalt or concrete. Soil samples were obtained from several areas and analyzed for % U_3O_8 and % ThO_2. Samples were extracted at various levels in five holes to determine depth of involvement. Samples were also taken to obtain a rough correlation between gamma readings and uranium/thorium content.

2.2 Cleanup Criteria

2.2.1 General

The cleanup criteria is dependent upon the use or future use of the property. New York State Regulations would apply with continuance of license. NRC Regulations would apply for delicensing.

2.2.2 New York State Regulations

NYS requires restriction of access to areas where the radioactive contaminants exceed 500 ppm of source materials. Below 500 ppm radioactive materials can be stored with unrestricted access.

To facilitate a comparison of this limit to the NRC limits a conversion to pCi/gm is made assuming a 2:1 (thorium:uranium) ratio. (See calculations attached).

These limits for unrestricted access are the total of the following:

≤36 pCi/gm Thorium
≤57 pCi/gm Uranium

These limits are used only for determination of compliance with our license for restricted or unrestricted access.

If the State is approached by UCC for criteria for delicensing they probably will require compliance with NRC Regulations due to Agreement State principles.

2.2.3 NRC Regulations

The NRC proposed regulations[1] provide four options for burial and delicensing. A fifth option deals with continuing the license.

(1) Federal Register/Vol. 46 No. 205/Friday Oct. 23, 1981, Notices (attached).

Option 1 ≤10 pCi/gm Thorium and/or 10 pCi/gm Uranium - unrestricted use and delicensing. (Burial not required).

Option 2&3 ≤50 pCi/gm Thorium and 40 pCi/gm Uranium - deed amendment and delicense, restricted access by burial with minimum four foot cover. No residential building. Option 2 specifies thorium and Option 3 uranium.

Option 4 ≤500 pCi/gm Thorium and 200 pCi/gm Uranium - much more restricted use of the land than Options 2 and 3. No excavation or building.

Option 5 of the Regulation deals with on-site storage of higher concentrations pending the availability of space at an approved repository. No burial is permitted.

2.3 Radiological Survey

2.3.1 Gamma Survey

The survey was performed with a portable gamma ray spectrometer, Model GR-410 manufactured by Geometries Exploranium and detector Model No. GPX-21 employing a sodium iodide thallium activated crystal as a scintillation phosphor.

All of the area south of Building 166 and bounded by the chain link fence was surveyed except areas covered by concrete or asphalt. The actual area surveyed was approximately 26,000 ft.^{2}. Concrete and asphalt cover 63,000 ft.^{2}.

A 10' x 10' grid was established and readings were taken at the intersection points. Extra readings were taken along the west track center line and near the edge of the concrete on both sides.

A resurvey of a 400 ft.^{2} area was done using a 2' x 2' grid to assess the reliability of the general survey. The location of this area is shown on Drawing SF-7902 as Detail 1. The data are also displayed in Figure I (attached).

All gamma meter readings were reduced to the number of times background and are reported on Drawing SF-7902.

2.3.2 Analytical Survey

Soil Samples - The physical samples were essentially 'grab' samples. No systematic sampling technique was used. The analytical work was performed by Elkem's laboratory at Niagara Falls. The results are shown in Table III (attached) and on Drawing SF-7902.

The chemical analyses of the surface soil samples ranged from 0.006% to 0.40% ThO_2 and from 0.002% to 0.17% U_3O_8.

2.4 Survey vs Regulations

The following Table I is a comparison of the surface soil sample analyses converted to pCi/g and the gamma radiation readings (times background). Below the table is a guide comparing gamma readings to cleanup or storage criteria. The gamma range is estimated based on the analyses of Table III (attached).

TABLE I

GAMMA X BKG	URANIUM pCi/gm	THORIUM pCi/gm	SAMPLE NO.	CONTAMINANTS PPM
1	3	2	11	20
3	11	11	9	131
5	6	6	8	70
6	11	19	2	210
8	8	22	5	228
9	14	40	1	401
12	26	61	3	650
13	8	12	10	140
17	26	66	4	674
21	42	105	12	1094
26	57	164	14	1664
33	82	201	13	2091
83	466	382	5	4957

GAMMA RANGE	NYS/NRC REQUIREMENTS
1 - 5	Will meet NRC proposed regulations for delicensing and unrestricted land use. NRC Option 1 (Sec. 2.3.3) - no burial required.
6 - 9	NYS allows unrestricted access and continue license. NRC allows burial and delicensing. Options 2 and 3 - burial required.
10 - 60*	NYS requires restricted access. NRC allows burial and delicensing - Option 4.
>60	NYS requires restricted access. NRC requires restricted access and storage until space is available at an approved repository, e.g., Barnwell, SC.

*Interpolated

2.5 Contamination Volume

2.5.1 General

The gamma survey, surface and subsurface soil analyses and the guide above are combined to estimate the quantity of material of each class in each area.

The depth of contamination varies throughout the area of involvement, but is generally less than six inches. However, to expedite cleanup, the rails and ties must be removed, requiring a minimum removal depth of eight inches.

2.5.2 High Concentration Area

This area contains material which exceeds NRC burial limits and must be disposed of (eventually) at an approved repository. Gamma readings are above 60 times background. This area is the most heavily contaminated both in radiation level and depth of contamination. Contamination can be found 12 inches below the surface.

Volume = 400 $ft.^2$ x 1 ft. deep = 400 $ft.^3$

2.5.3 Medium Concentration Area

This area contains material which requires restricted access. Gamma readings are 10-60 times background.

Volume = 6400 $ft.^2$ x 2/3 ft. deep = 4267 $ft.^{3*}$

*Approximately 30% of the area found to be low concentration on the general survey (10' x 10' Grid) was found to be medium concentration upon resurvey (2' x 2' Grid). See Drawing SF-7902 or Figure I. This volume is included.

2.5.4 Low Concentration Area

This area contains material which must be removed to delicense but which can remain with unrestricted access under current license. Gamma readings are 6-9 times background.

Volume = 2200 $ft.^2$ x 2/3 ft. deep = 1467 $ft.^3$

2.5.5 Summary

The following summarizes the above volumes including a 15 percent contingency:

High Concentration	- 230 $ft.^3$
Medium Concentration	- 4900 $ft.^3$
Low Concentration	- 1700 $ft.^3$
TOTAL	6830 $ft.^3$

NOTE: No exploration was done beneath any of the concrete or asphalt pads. The depth of involvement and the location of contamination along the railroad tracks indicates the radioactive materials were spilled during handling from rail cars and contamination under the pads is unlikely.

3.0 DESCRIPTION OF CLEANUP ALTERNATIVES

3.1 Summary

Five cleanup alternatives are considered in this memorandum. The major factors influencing final selection of an alternative are: term of solution (short or long), delicensing, property transfer to Elkem, compliance with NYS Regulations, and cost.

Table II below summarizes the alternatives opposite these factors.

TABLE II

ALTERNATIVE NO.	DESCRIPTION	TERM	DELICENSE*	TRANSFER PROPERTY TO ELKEM	COST $000
1	Fence in place	Short	No	No	10
2	Remove & fence on Elkem Property	Short	No	No	65
3	Remove & fence on UCC Property	Medium	No	Yes	120**
4	Remove & bury - UCC Niagara	Long	Yes	Yes	175
5	Remove & ship to repository	Permanent	Yes	Yes	335

* Assumes that this is the only contaminated area in the plant.

**If a concrete pad is available the cost would be $90,000.

3.2 Alternative No. 1 - Fence in Place

Simply enclose the contaminated area thus restricting access.

Requirements - 400 feet of fence.

Advantages - Quick solution to come into compliance with NYS.
- Minimum cost.

Disadvantages - Contamination remains requiring future action.
- Transfer of property to Elkem is not possible unless Elkem obtains a license or UCC removes the material.

3.3 Alternative No. 2 - Remove and Fence on Elkem Property

As mentioned earlier, much of the area South of Building 166 is covered with concrete and asphalt. The material (soil) could be removed and stored on an existing pad in the Southeast corner of the property. The pad and a plastic covering would provide stability and a fence would provide restricted access until final disposal.

Requirements
- Removal of railroad tracks.
- Disposal of scrap and debris**.
- 100 ft. fence required - S & E corner site.
- Concrete/asphalt pad - already available.
- Replacement of railroad track.

Advantages
- Consolidation of contaminants.
- Access can be restricted.
- This work is required for ultimate disposal in any event.

Disadvantages
- Short term solution.
- 1/10 acres of land would not be available for Elkem use.
- Transfer of property to Elkem is not possible unless Elkem obtains a license or UCC removes the material.

**This includes
- Three flat bed railroad cars loaded with induction furnaces.
- Stacks of deteriorating 55 gallon drums.
- Stacked wooden boxes containing steel shot, etc.
- Numerous 5' x 5' x 5' steel boxes.
- Various ladles, furnaces, carbon electrodes, etc.

3.4 Alternative No. 3 - Remove and Fence on UCC Property

The work required here is essentially the same as in 3.3 above. Costs increase and extra care must be taken to avoid contamination of other areas of the plant. However, the property can then be released for transfer to Elkem. An area in the Niagara Plant has been designated by plant personnel for possible use.

Requirement
- Same as 3.3 except more fence and a new concrete pad may be required.

Advantage
- Same as 3.3 except it has the additional advantage of not interfering with Elkem property use. Property can be transferred to Elkem.

Disadvantage
- Medium term solution.

3.5 Alternative No. 4 - Remove and Bury - UCC Niagara

Burial on Union Carbide owned property was explored for the Marietta TaCb cleanup project. The main problems are: finding a suitable burial site, getting State and Local approval, future use or transfer of the burial site is restricted, and long term monitoring of the site is necessary.

Requirements
- Remove and replace railroad tracks.
- Dispose of scrap and debris at approved repository.
- A suitable burial site.
- Containers (55 gallon drums) may be required.
- Dispose of 400 $ft.^3$ soil at approved repository.

Advantages
- Long term solution.
- Delicense.

Disadvantages
- Use of the burial site will be restricted - no construction.

3.6 Alternative No. 5 - Remove and Ship to Repository

This alternative is permanent. Once the material is received at the repository, the host state becomes owner and the licensee's accountability ends. However, this is the most expensive alternative.

Requirements
- Remove and replace railroad tracks.
- Disposal of scrap and debris at approved repository.
- Containers.
- Loading system.

Advantage
- Permanent solution.

Disadvantage
- Highest cost.

3.7 Remove and Ship to Uravan

This alternative was selected for the TaCb residue cleanup project in Marietta. The uranium content of the TaCb residue was 0.13% U_3O_8 and processing to recover uranium values was feasible and acceptable to the Colorado Department of Health. The material (soil) analyses at Niagara indicate 0.01% U_3O_8. Therefore, transfer to Uravan cannot be considered.

4.0 COST ESTIMATES

As discussed in Section 2.4, the radiological survey indicates three levels of contamination above NRC delicensing limits. They are: 6-9 x BKG (background), 10-60 x BKG and greater than 60 x BKG. Volumes were calculated

for each area with the thought that some alternatives would not require the removal of the combined total volume but only those areas with the highest concentrations. However, to simplify costings and cost comparison, only the total volume of Section 2.5.5 is considered. All medium and high concentration material requires fencing or removal. The low concentration material adds an additional 25% to the volume, but adds only 10% to the cost. The volume for cost estimating is then 6830 ft.^{3}.

Cost Estimates No. 6342 through 6346 are attached.

Cost Estimate No. 6342	Fence in Place	$ 10,000
Cost Estimate No. 6343	Remove and Fence - Elkem	$ 65,000
Cost Estimate No. 6344	Remove and Fence - UCC Niagara	$120,000
Cost Estimate No. 6345	Remove and Bury - UCC Niagara	$175,000
Cost Estimate No. 6346	Remove and Ship to Barnwell	$335,000

Note. Costs do not reflect removal of debris which is assumed to be Elkem's accountability.

5.0 RECOMMENDATIONS

Removal and relocation of the contaminated soil to the Niagara plant as described in Alternative No. 3 is recommended based on the following

1. The property will be deeded to Elkem Metals Company.

2. Any restriction to the use of the property behind Building 166, or any potential cleanup liability to Elkem, is unacceptable.

3. EPA and NRC regulatory uncertainties exist concerning burial. (Perpetual maintenance costs are not included in the estimate for Alternative No. 4.) Burial also makes the material unavailable for disposal at an approved repository as discussed below. New York state may ban all burial within the state in the near future.

4. Disposal at Barnwell, SC is too costly and there is reason to believe that a new repository will be opened in the Northeast by 1986 which may reduce the cost of that option.

Any remedial effort must be approved by the State of New York, Department of Labor. For the material to be left on-site, Radioactive Materials License No. 950-0139 must be amended. This amendment or some form of approval should be received prior to the beginning of any cleanup.

Niagara Falls, New York
May 19, 1983

Cost Estimate No. 6342

File No. 11309

Revised: July 6, 1983

UNION CARBIDE CORPORATION
METALS DIVISION
TECHNOLOGY DEPARTMENT - ENGINEERING
SPONSOR: T. J. KAGETSU

FEASIBILITY STUDY COST ESTIMATE
DECONTAMINATION BUILDING 166 - FENCE IN PLACE (ALTERNATIVE 1)

	1983 DOLLARS	MATERIAL $000	LABOR $000	CAPITAL $000	NON-CAPITAL $000
100	MATERIAL				
101	400' Fence (6 ft.) Along 1100N	-	8	8	-
	TOTAL		8	8	-
	TOTAL DIRECTS		8	8	-
	ENGINEERING			-	-
	CONTINGENCY			2	
	RADIOLOGIST/HEALTH PHYSICS (1 Mo.)			-	-
	TOTAL			10	-

FRANGELORI/dac

cc: TJK(2): CGR: AJC: LGE: RGH: FRA(4)

Niagara Falls, New York
May 19 983

Cost Estimate No. 6343

File No. 11309

Revised: July 6, 1983

UNION CARBIDE CORPORATION
METALS DIVISION
TECHNOLOGY DEPARTMENT - ENGINEERING
SPONSOR: T. J. KAGETSU

FEASIBILITY STUDY COST ESTIMATE
DECONTAMINATION BUILDING 166 - REMOVE AND FENCE ELKEM (ALTERNATIVE 2)

	1983 DOLLARS	MATERIAL $000	LABOR $000	CAPITAL $000	NON-CAPITAL $000
100	SOIL REMOVAL				
101	Remove & Relocate Soil 7000 ft.^{3}	-	5	-	5
102	Fence 6 ft. - 100 ft.	-	2	-	2
	TOTAL		7		7
200	RECLAMATION				
201	Backfill	-	5	5	-
202	Equipment Decontamination (Loader & Trucks)	-	3	3	-
203	Replace RR Track	-	25	15	10
	TOTAL		33	23	10
	TOTAL DIRECTS		40	23	17
	ENGINEERING			7	5
	CONTINGENCY			8	3
	RADIOLOGIST/HEALTH PHYSICS			2	-
	TOTAL			40	25

FRANGELORI/dac
cc: TJK(2): CGR: AJC: LGE: RGH: FRA(4)

Niagara Falls, New York
May 19, 1983

Cost Estimate No. 6344

File No. 11309

Revised: July 6, 1983

UNION CARBIDE CORPORATION
METALS DIVISION
TECHNOLOGY DEPARTMENT - ENGINEERING
SPONSOR: T. J. KAGETSU

FEASIBILITY STUDY COST ESTIMATE
DECONTAMINATION BUILDING 166 - REMOVE AND FENCE - UCC NIAGARA (ALTERNATIVE 3)

	1983 DOLLARS	MATERIAL $000	LABOR $000	CAPITAL $000	NON-CAPITAL $000
100	SOIL REMOVAL				
101	Remove & Relocate Soil 7000 ft.^{3} (haul)	-	10	-	10
102	Concrete Pad - 60 cy.	-	30	30	-
103	Fence 6 ft. - 200 ft.	-	4	4	-
	TOTAL		44	34	10
200	RECLAMATION				
201	Backfill	-	5	5	-
202	Equipment Decontamination (Loader & Trucks)	-	3	3	-
203	Replace RR Track	-	25	15	10
	TOTAL		33	23	-
	TOTAL DIRECTS		77	57	20
	ENGINEERING			9	6
	CONTINGENCY			10	2
	RADIOLOGIST/HEALTH PHYSICS (1 Mo.)			14	2
	TOTAL			90	30

FRANGELORI/dac
cc: TJK(2): CGR: AJC: LGE: RGH: FRA(4)

Niagara Falls, New York
May 19, 1983

Cost Estimate No. 6345

File No. 11309

Revised: July 6, 1983

UNION CARBIDE CORPORATION
METALS DIVISION
TECHNOLOGY DEPARTMENT - ENGINEERING
SPONSOR: T. J. KAGETSU

FEASIBILITY STUDY COST ESTIMATE
DECONTAMINATION BUILDING 166 - REMOVE AND BURY - UCC NIAGARA (ALTERNATIVE 4)

	1983 DOLLARS	MATERIAL $000	LABOR $000	CAPITAL $000	NON-CAPITAL $000
100	SOIL REMOVAL				
101	Remove & Relocate Soil 7000 ft.^{3} (haul)	-	10	-	10
102	Clay Lined Pit w/Drain System 40 ft.^{2} x 5 ft.	-	15	15	-
103	Clay Cap	-	15	15	-
	TOTAL		40	30	10
200	RECLAMATION				
201	Backfill	-	5	5	-
202	Equipment Decontamination (Loader & Trucks)	-	3	3	-
203	Replace RR Track	-	25	15	10
	TOTAL		33	23	10
300	DISPOSAL				
301	Transportation	-	1	-	1
302	Burial Fee (200 ft.^{3})	1	8	-	9
	TOTAL	1	9		10
	TOTAL DIRECTS	1	82	53	30
	ENGINEERING			8	8
	CONTINGENCY			15	5
	RADIOLOGIST/HEALTH PHYSICS (1 Mo.)			4	2
	SITE SELECTION			35	
	TOTAL			125	50

FRANGELORI/dac
cc: TJK(2): CGR: AJC: LGE: RGH: FRA(4)

Niagara Falls, New York
May 1[redacted]1983

Cost Estimate No. 6346

File No. 11309

Revised: July 6, 1983

UNION CARBIDE CORPORATION
METALS DIVISION
TECHNOLOGY DEPARTMENT - ENGINEERING
SPONSOR: T. J. KAGETSU

FEASIBILITY STUDY COST ESTIMATE
DECONTAMINATION BUILDING 166 - REMOVE AND SHIP TO BARNWELL, SC (ALTERNATIVE 5)

	1983 DOLLARS	MATERIAL $000	LABOR $000	CAPITAL $000	NON-CAPITAL $000
100	SOIL REMOVAL				
101	Remove Soil 7000 ft.^{3} (haul)	-	5	-	5
102	Containers (80 boxes - 100 ft.^{3})	20	-	-	20
103	Loading Trucks (incl. Pallets, etc.)	5	4	-	9
	TOTAL	25	9		34
200	RECLAMATION				
201	Backfill	-	5	5	-
202	Equipment Decontamination (Loader & Trucks)	-	3	3	-
203	Replace RR Track	-	25	15	10
	TOTAL		33	23	10
300	DISPOSAL				
301	Transportation 1000_3$ (10 loads)	-	10	-	10
302	Burial Fee (8000 ft.^{3} incl Container)	-	160	-	160
	TOTAL		170		170
	TOTAL DIRECTS	25	212	23	214
	ENGINEERING			5	28
	CONTINGENCY			3	46
	RADIOLOGIST/HEALTH PHYSICS (1 Mo.)			4	2
	TOTAL			45	290

FRANGELORI/dac
cc: TJK(2): CGR: AJC: LGE: RGH: FRA(4)

CALCULATIONS

New York State regulations require that access be restricted to areas where the source material exceeds 500 ppm. For the purpose of comparison with NRC regulations a Thorium/Uranium ratio of 2:1 is assumed.

Therefore, the maximum activities for unrestricted access are:

NYS maximum Thorium activity equals:

$$330 \text{ parts/million} \times 1.09 \times 10^5 \text{ pCi/gm} = 36 \text{ pCi/gm}$$

NYS maximum Uranium activity equals:

$$170 \text{ parts/million} \times 3.33 \times 10^5 \text{ pCi/gm} = 57 \text{ pCi/gm}$$